REMARKS

Please reconsider the application in view of the above amendments and the following remarks. Applicants thank the Examiner for carefully reviewing this application.

At the outset, Applicants note that the correct title of the invention as filed and as used in the subsequent communications is as follows:

> SOIL MEASURING APPARATUS, SOIL MEASUREMENT ASSISTING DEVICE AND METHOD, RECORDING MEDIUM ON WHICH A PROGRAM IS RECORDED, RECORDING MEDIUM ON WHICH DATA IS RECORDED, APPLICATION AMOUNT CONTROLLER, APPLICATION AMOUNT DETERMINING DEVICE, METHOD FOR THEM, AND FARM WORKING DETERMINATION ASSISTING SYSTEM

Applicants noticed that the title shown on the official filing receipt includes three minor typographic errors. Applicants respectfully request that the Examiner use the correct title as shown as above for this case.

Applicants thank the Examiner for considering the references cited in the Information Disclosure Statements (IDS) filed on May 6, 2003 and August 18, 2003, and for forwarding the initialed copies of the Form PTO-1449. However, Applicants respectfully note that another IDS was submitted with the application on January 8, 2002. Applicants respectfully request an initialed copy of the Form PTO-1449 for this IDS, or if the IDS has not already been considered, prompt consideration of the same

Disposition of Claims

Claims 1-26 and 33 were pending in the application. New claims 34-39 are added by this reply. Therefore, claims 1-26, 33 and 34-39 are currently pending in this application. Claims 1, 2, 5-11, 16-19, 21, 22, 26 and 33 are independent. The remaining claims depend, directly or indirectly, from claims 2, 3, 9-11, 17-19, and 22.

Amendments

1. The specification has been amended to correct typographic errors. No new matter is

introduced by these amendments.

2. Claims 1-26 and 33 have been amended to correct typographic errors and to clarify the invention recited. New claims 34-39 are added. These new claims are based on the original claims 13-15, which included improper dependency. No new matter has been introduced by these amendments.

Objection(s)

(A) Figure 1 was objected to as not including the label "prior art."
A replacement drawing sheet showing the "prior art" label in the amended Figure 1 is included in this reply. Accordingly, withdrawal of this objection is respectfully requested.

(B) The specification was objected to on the basis of grammatical, spelling and punctuation errors. The Applicant thanks the Examiner for carefully reviewing the specification. The specification has been reviewed for errors and attempts have been made to make corrections to grammar, punctuation and spelling to help clarify the meaning. Accordingly, withdrawal of this objection is respectfully requested.

(C) Claims 13-15 were objected to as being improper multiple dependent claims. These claims have been amended to remove the improper multiple dependency. Accordingly, withdrawal of this objection is respectfully requested.

Rejection(s) under 35 U.S.C § 103

Claims 1-26 and 33 stand rejected under 35 USC § 103(a) as being unpatentable over Monson et al. ('491) in view of Bach et al. Claims 1-26 and 33 have been amended in this reply to clarify the recited invention. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

The present invention relates to apparatus and methods for measuring soil properties. A method in accordance with embodiments of the invention uses a soil measuring apparatus to acquire soil property data, which are then inputted into a soil model to compute the soil properties.

The data to be inputted into the model may be acquired based on measurement conditions determined from information related to the soil type (the type of soil) and/or water content of the measurement site. (Specification, p. 5, lines 5-14). The information related to the soil type and/or water content to be used to determine measurement conditions may be available from prior surveys or from preliminary measurements performed before the data acquisition. (Specification, p. 22, lines 4-8).

A soil measuring apparatus suitable for use with embodiments of the invention may comprise a detecting means and a processing means. The detecting means is for acquiring the measurement data, while the processing means is for calculating the soil properties based on the measurement data and a model that may be pre-stored on the processing means. The model used in the calculation is determined based on the information related to the soil type and/or the water content of the measurement site. (Specification, p. 5, lines 15-25).

An apparatus in accordance with embodiments of the invention may further comprise a soil measurement assisting device. The soil measurement assisting device may comprise a storage means and a determining means. In particular embodiments, the storage means is for storing, for example, soil measurement data (which may include information related to the soil type and/or the water content of the measurement site), models for calculating soil properties, and measurement conditions. Further, the determining means is for (i) acquiring information related to the soil type and/or the water content of the measurement site, (ii) accessing the storage means to determine a suitable soil model and suitable measurement conditions for further data measurements, and (iii) outputting the model and the measurement conditions to the main soil measurement apparatus. (Specification, p. 8, line 18 – p. 9, line 3).

The measurement assisting device may be used in a soil measurement assisting method. A soil measurement assisting method in accordance with embodiments of the invention may involve the following steps: (i) preparing the storage means for storing soil measurement data, (ii) acquiring preliminary measurement data related to the soil type and/or water content of the measurement site, (iii) accessing the storage means to determine a suitable soil model and/or measurement conditions (for further measurements) based on the soil type and/or water content from the preliminary measurement, and (iv) outputting the soil model and/or the measurement conditions to the main measuring apparatus. (Specification, p. 8, lines 3-17).

As discussed in the present specification, water content has a significant influence on the

soil measurement data. For example, similar or same soil samples having different water contents may produce measurement data that are substantially different. Conversely, different soil samples may produce similar measurement data due to the influence of different water contents. (Specification, p. 6, lines 17-23). Thus, if the water content is treated like any other soil parameter, as in prior art methods, the model used may not accurately reflect the soil of the measurement site and the parameters derived may not be accurate.

For this reason, embodiments of the invention treat the water content as a higher level parameter, separate from other soil properties, and uses it to determine the proper soil model for deriving soil properties and/or to determine proper measurement conditions for acquiring measurement data that are to be inputted into the model. The water content of a soil may be determined by measuring infrared absorption at 1,850 nm. (Specification, p. 36, lines 1-10). Methods for deriving the water contents from this measurement are described on pages 36 and 37 of the specification and are illustrated in Figure 7.

Similarly, the type of soil at the measurement site has an impact on the design of measurement conditions and/or the selection of a proper soil model to be used in the calculation. Therefore, embodiments of the invention may also use the soil type as a higher level parameter to determine a proper soil model and/or to determine the proper measurement conditions for data acquisition. The type of soil may be classified according to the application. For example, for agriculture use, the types of soils may be defined by the color of the soil, the size of the soil particles, and the texture of the soil. (Specification, p. 19, lines 23-26).

Thus, according to embodiments of the invention, measurement data are used in a hierarchical (two-level) manner. First, information related to the soil type and/or information related to the water content is used as "higher-level" parameter to design measurement conditions (for further measurement) and/or to select a proper soil model (for deriving the soil properties). Other measurement data, which may be further measurement data acquired based on the measurement conditions determined based on the soil type and/or water content, are then used in the selected soil model, in a second step, to derive the soil properties.

Thus, in accordance with embodiments of the invention, information related to soil types and water contents are not included in the soil model. Instead, they are used as higher level parameters to determine soil models. Accordingly, in a database, information related to the soil types and information related to the water contents are stored at the same level as the soil models –

same hierarchical fields in a record.

By using the information on the type of soil and water content of the measurement site to design measurement conditions, the measurement data will be more reliable and can produce more accurate soil properties. Similarly, by using the soil type and/or water content to determine the proper soil model for the calculation, the resultant soil property estimates will be more accurate.

All independent claims recite embodiments related to the hierarchical use of the soil type and/or water content parameters to determine the measurement conditions and/or a proper soil model. Specifically, independent claims 1, 2, and 5-11 each include one or both of the following limitations: (i) acquiring measurement data . . . based on information related to at least one parameter selected from a soil type of a measurement site and a water content of the soil; and (ii) a model (and/or measurement conditions) . . . determined based on the information related to at least one parameter selected from the soil type . . . and the water content.

Independent claim 16 recites a method in which a preliminary measurement data related to optical properties of the measurement site is used to determine a preliminary soil model. A second set of measurement data related to chemical components of the soil is obtained and used to modify the preliminary soil model. This method also uses measurement data (optical and chemical component data) in a hierarchical manner to determine a model for deriving soil properties.

Independent claims 17-19 each include the following limitations: (i) acquires initial measurement data related to a soil type and a water content of a measurement site; and (ii) measurement conditions (and/or model) determined based on the initial measurement data.

Independent claim 21 relates to a soil measuring apparatus that includes "a soil measurement assisting device that determines . . . a soil type of the measurement site, a model . . . based on information related to a water content of the soil, and measurement conditions for acquiring further measurement data."

Independent claim 22 relates to a recording medium storing information that includes "a soil type, information related to a water content of a soil, a model for calculating soil properties, and soil measurement data correlated with measurement conditions to be imputed into the model." The information related to the soil types and the water contents are stored at the same level as the models, rather than as parameters inside the models, so that these parameters may be used to determine a suitable soil model.

Independent claim 33 relates to a soil model database control system, "wherein the soil

model database stores at least a soil type, information related to water contents of a soil, soil measurement data for calculating soil properties, and soil correlation information." Again, the information related to soil types and the water contents is treated as higher level parameters.

In contrast, prior art apparatus and methods treat water content and/or soil type as regular parameters in the soil model. Thus, prior art apparatus will not have a measurement assisting device for measuring soil type and/or water content as preliminary measurement data for determining further measurement conditions and soil models. Similarly, prior art methods treat the soil type and/or water content as general parameters that are extracted from measurement data by using a model.

For example, Monson et al. discloses "[a]dditional data, including data from other testing assemblies can be used to correlate data to determine organic matter content. For example . . . soil moisture data may be used to factor in moisture content for the reflectance data to isolate the influence of moisture content on the reflectance data." (Col. 8, lines 13-22). Thus, according to Monson et al. other data (*e.g.*, water content) may be included to derive the organic matter content from the reflectance data. The information related to water content is used together with other data in a general soil model that is not specifically determined based on water content of the soil. Thus, Monson et al. fail to teach or suggest the use of a soil type or water content of the soil, in a hierarchical manner, to design the measurement conditions (for further measurements) or to select a suitable soil model for calculating soil properties.

Bach et al. disclose methods using modeling to derive water contents on the surface of the soil and in the soil. The concept of the model takes into account two processes. First, the total internal reflection of the reflected radiance in a water layer covering the soil, which leads to a general darkening of the soil. Second, the absorptions of the water contained in the soil in certain spectral regions. (Abstract). Thus, the methods of Bach et al. aim at providing accurate estimates of water contents from reflectance data. They use a general model and measurement data to extract water content information. Extraction of the water content is the *aim*. This is in contrast to the present invention, in which the water content is a *means* for determining better measurement conditions and a better soil model. Thus, Bach et al. fail to disclose or suggest using water content to design measurement conditions or to select a suitable soil model for deriving soil properties.

Because neither Monson et al. nor Bach et al. teach or suggest using a soil type and/or water content of the measurement site in a hierarchical manner to determine measurement

conditions and/or to determine a suitable soil model for calculating soil properties, these references, whether considered separately or in combination, cannot anticipate or render obvious the invention cited in independent claims 1, 2, 5-11, 16-19, 21, 22, and 33. Dependent claims are patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

New Claims

New claims 34-39 depend from claims 12-14 and, therefore, are patentable for at least the same reasons.

Conclusion

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 04730.003001)

Respectfully submitted,

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